Land-cover changes detected by combining airborne lidar and hyperspectral data

Christopher Macon

Joint Airborne Lidar Bathymetry Technical Center of Expertise

Community of Practice 2008
19 May 2008
San Antonio,TX

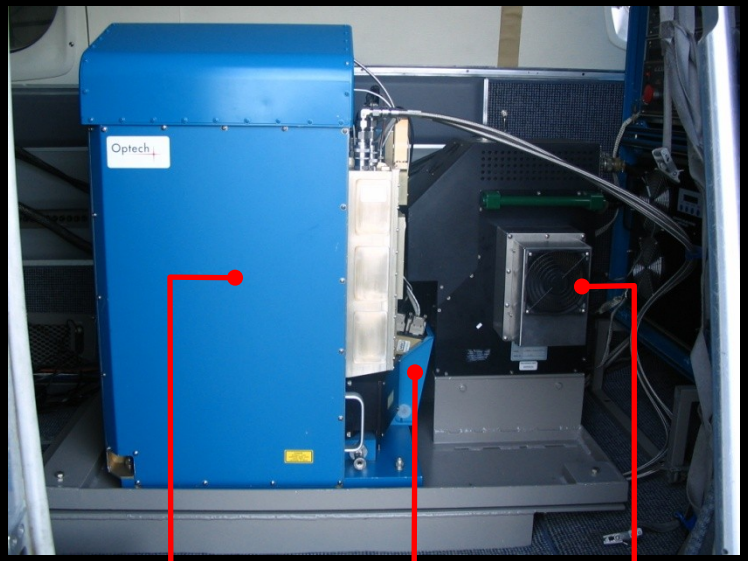
Outline

- JALBTCX
  - CHARTS
    - SHOALS
    - CASI
- NCMP
  - Surveys
    - Classification
      - Comparision
        - Examples
          - Summary

Joint Airborne Lidar Bathymetry Technical Center of Expertise

Operations
Technology Evolution
USACE
Navy
Coastal Measurements & Data Usage
Sensors & Systems
NOAA
Optech
itres
US Army Corps of Engineers MOBILE DISTRICT
U. S. Naval Research Laboratory Stennis Space Center, MS
EARTH SCIENCE APPLICATIONS DIRECTORATE John C. Stennis Space Center
Welcome to the US Army Corps of Engineers
Engineer Research and Development Center
Waterways Experiment Station, Vicksburg, MS
Department of Marine Science of The University of Southern Mississippi
NAVAL OCEANOGRAPHIC OFFICE
NOAA Satellites and Information
National Environmental Satellite, Data, and Information Service
FUGRO
3001 the geospatial company
NAVAL METEOROLOGY AND OCEANOGRAPHY COMMAND
NAVAL OCEANOGRAPHIC OFFICE
NOAA

CHARTS sensor suite



Optech SHOALS-3000 Integrated Laser System

DuncanTech-4000 RGB camera

Itres CASI-1500 Hyperspectral Imager

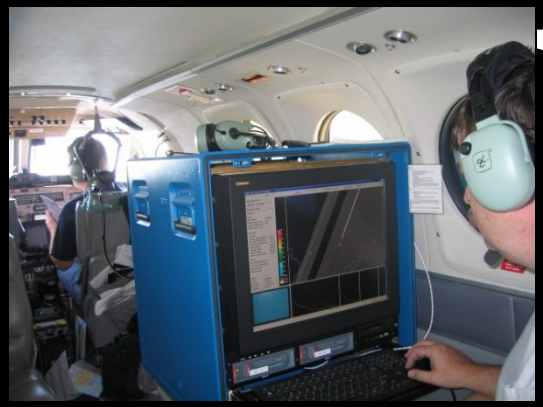
Bottom Aircraft Port

CHARTS

COMPACT HYDROGRAPHIC AIRBORNE RAPID TOTAL SURVEY

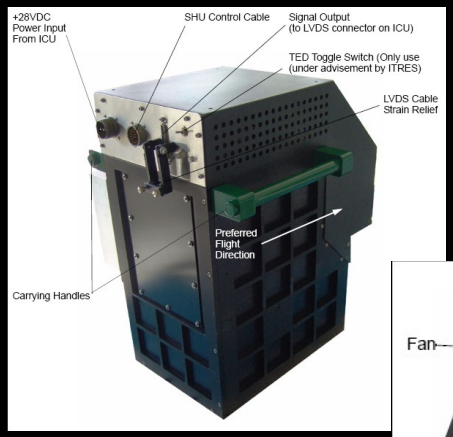
SHOALS-3000

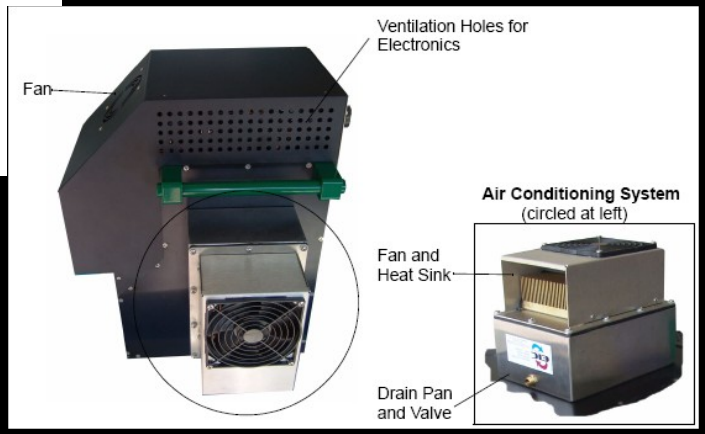
- Laser pulse rate
  - 3,000 Hz hydro
  - 20,000 Hz topo
- Laser spot spacing
  - 2 – 5 m hydro
  - 1 – 2 m topo
- Elevation accuracy
  - ±30 cm at 95% hydro
  - ±15 cm at 95% topo
- Flight altitude
  - 300 – 400 m hydro
  - 300 – 1200 m topo
- Flight speed
  - 135-165 knots
- RGB images
  - Georeferenced
  - 1 Hz, 60% alongtrack overlap
  - 20 – 50 cm pixel resolution
  - jpg format

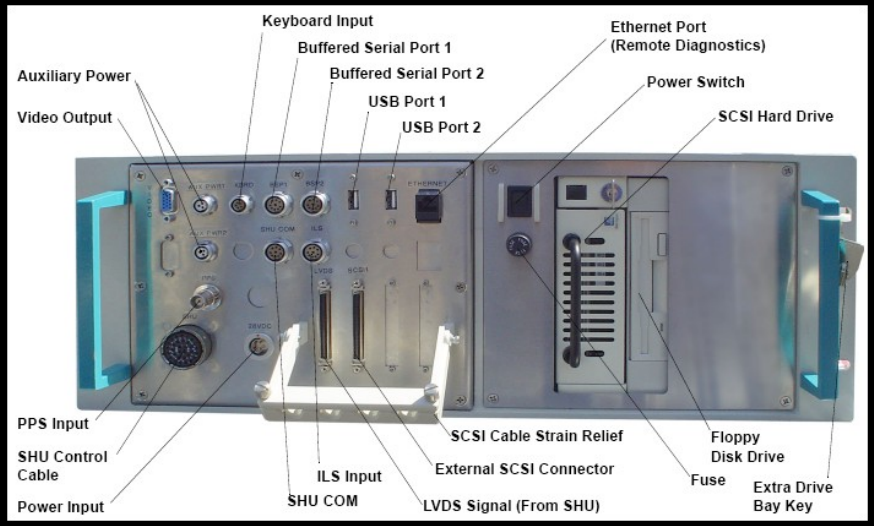


CASI-1500

- Field of view
  - 40° acrosstrack
  - 0.028 ° alongtrack
- Spectral range
  - 375-1050 nm
- Spectral samples
  - 288 at 1.9 nm intervals
- Aperture
  - f/2.8 to f/10
- Dynamic range
  - 16384:1 (14 bits)
- Noise floor
  - ~ 3.0 DN
- Signal to noise ratio
  - 480:1 peak
- Calibration accuracy
  - 470 – 800 nm 2%
  - 430 – 870 nm 5%
- Data throughput
  - 6 Mpixel/s


+28VDC Power Input From ICU
SHU Control Cable
Signal Output (to LVDS connector on ICU)
TED Toggle Switch (Only use (under advisement by ITRES)
LVDS Cable Strain Relief
Preferred Flight Direction
Carrying Handles





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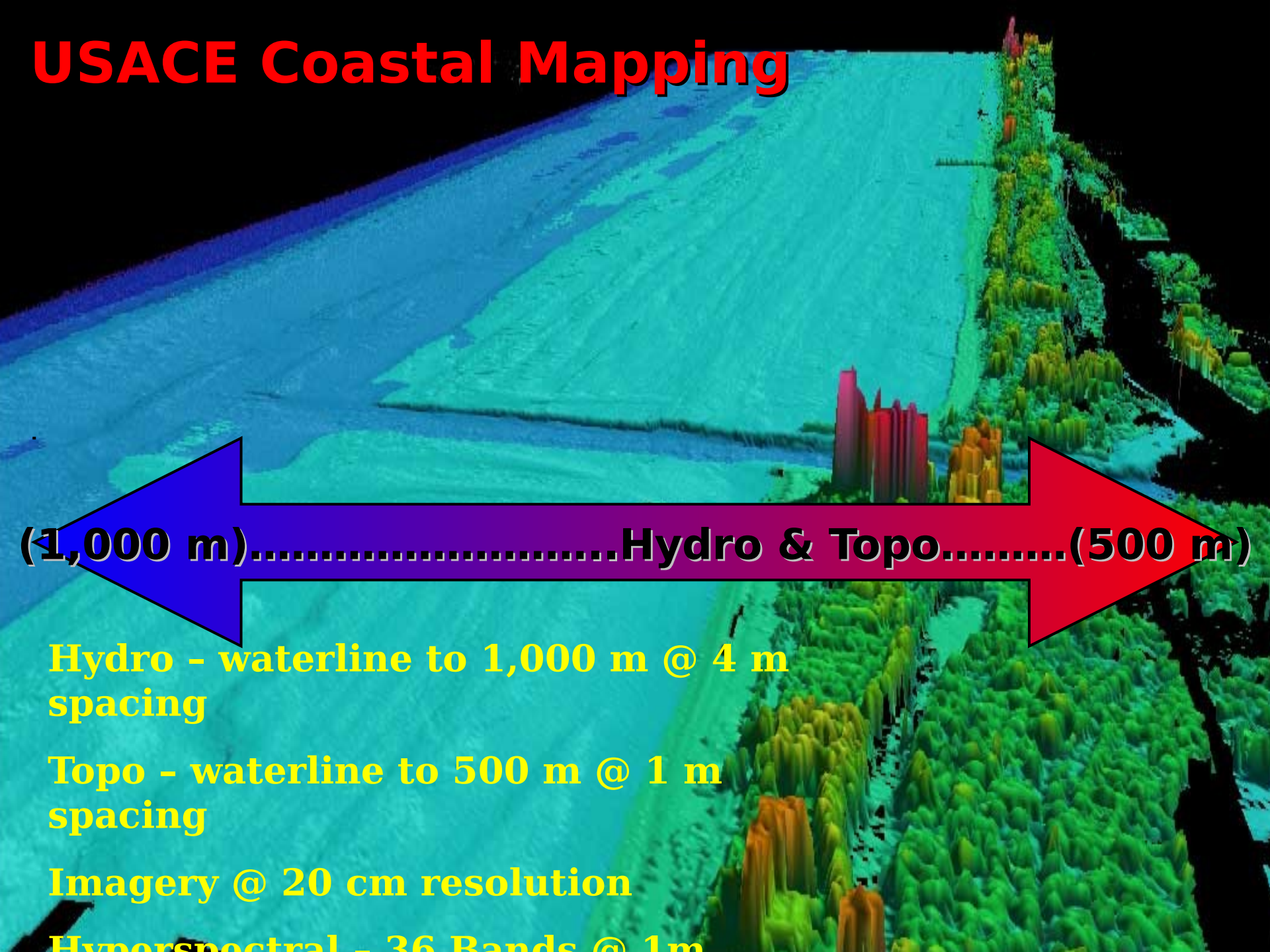
National Coastal Mapping Program

- Initiated in FY2004
- Regional measurements

- 8-yr survey cycle
- Partner with other agencies
- Annual Planning Meetings

USACE Coastal Mapping



- Hydro – waterline to 1,000 m @ 4 m spacing
- Topo – waterline to 500 m @ 1 m spacing
- Imagery @ 20 cm resolution
- Hyperspectral – 36 Bands @ 1m

NCMP FY 2008

Saltspring Island
Patos Island
Stuart Island
Lummi Island
Sydney Island
San Juan Island
Lopez Island
Fidalgo Island
Whidbey Island
Camano Island
Bainbridge Island
Vashon Island
Anderson Island
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Image NASA
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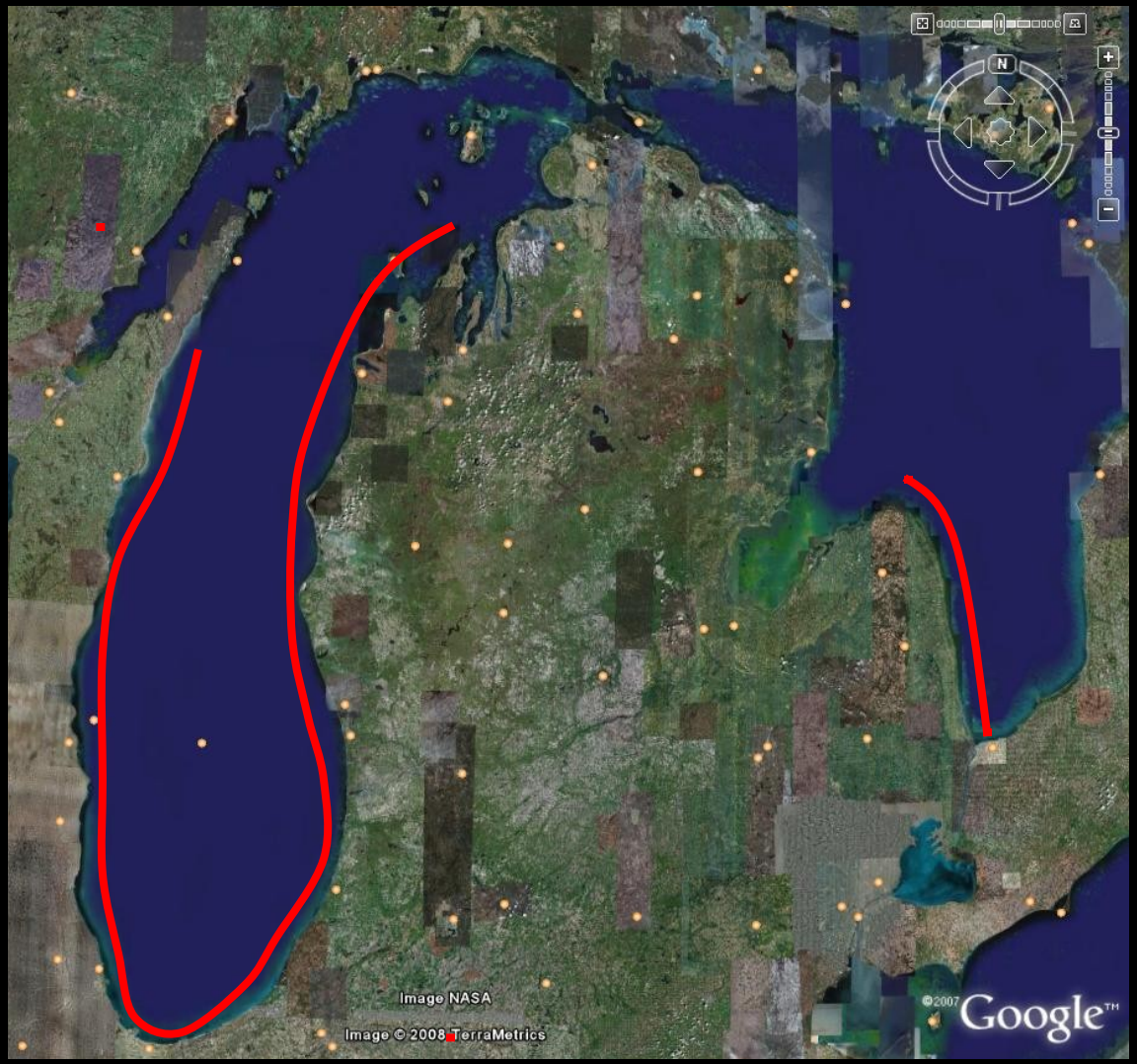
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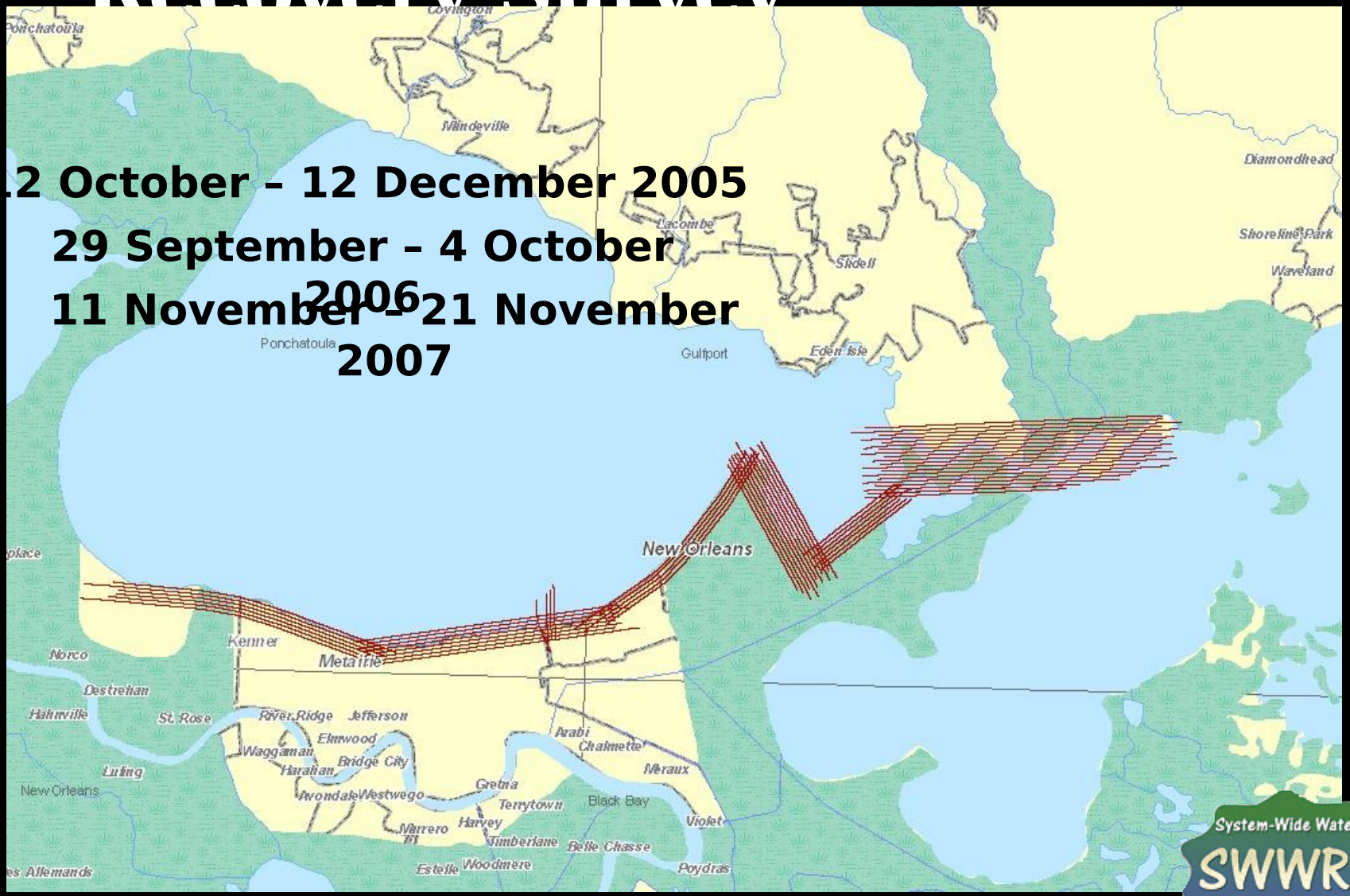
Image NASA
Image © 2008 TerraMetrics
©2007 Google™

Hurricane Katrina Recovery Survey



Hyperspectral Coverage

System-Wide Water Resources Program
SWWRP

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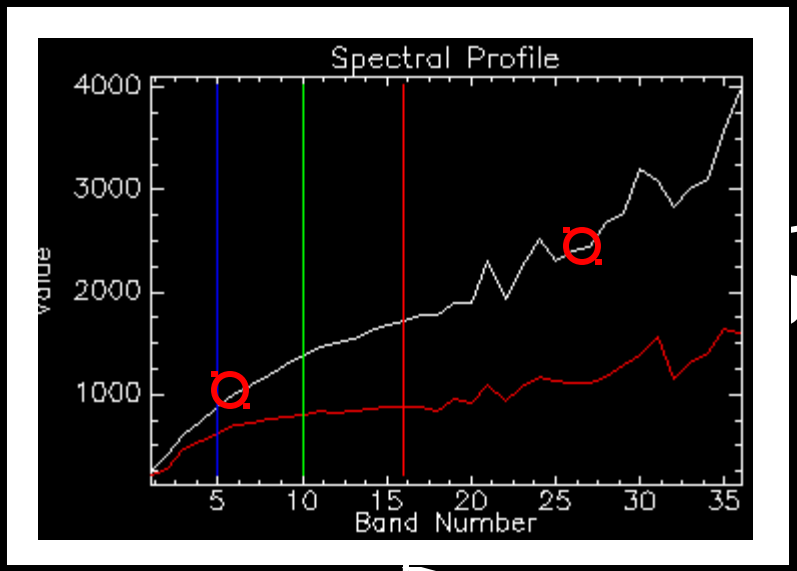


Image

Data

No Data

Land/Water

Saturated Pixels

Veg/Non-Veg

Water

Non-Veg

Vegetation

Ground

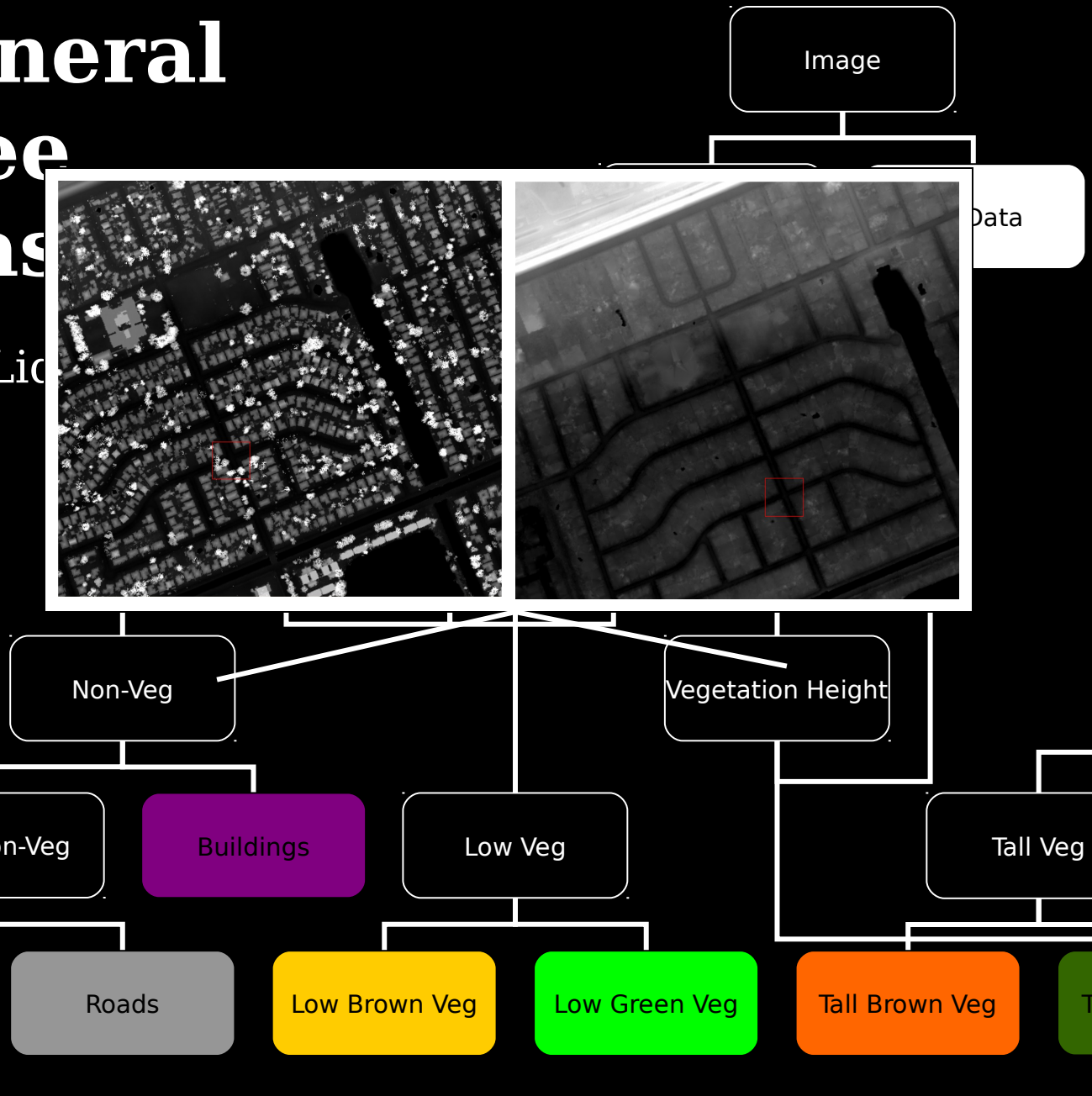
Man-Made

Brown Veg

Green Veg

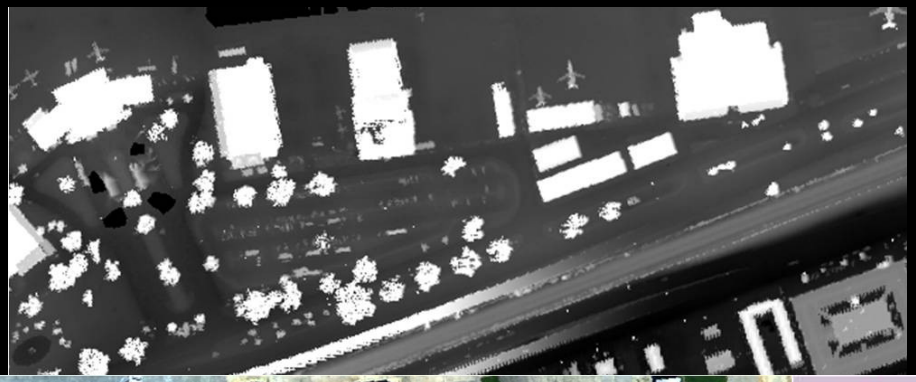
General Tree Clas n

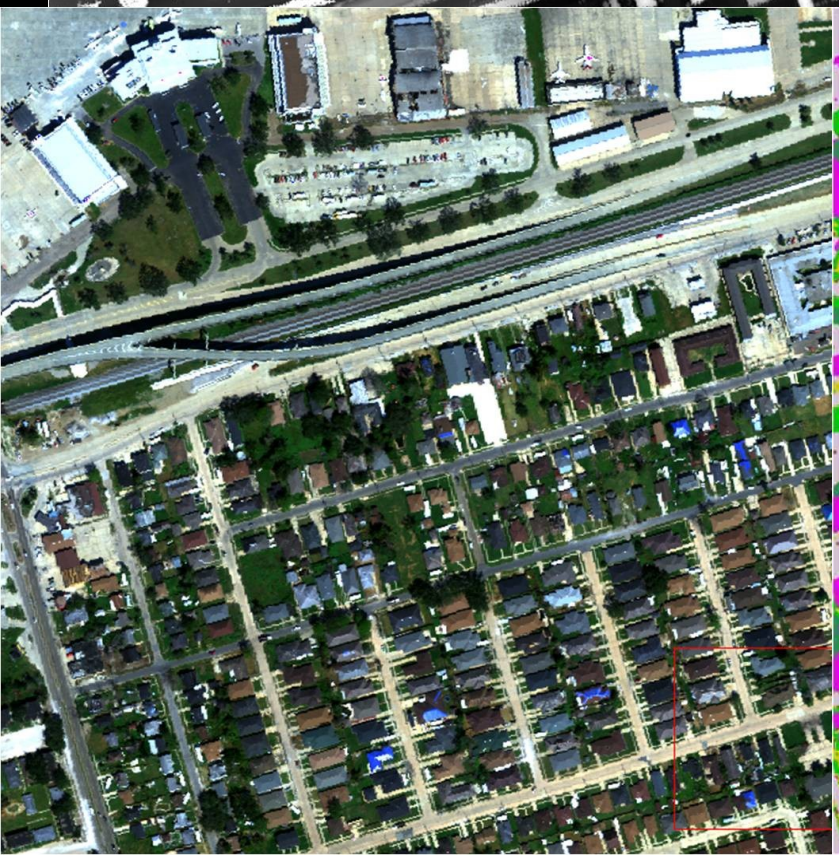
With Lic

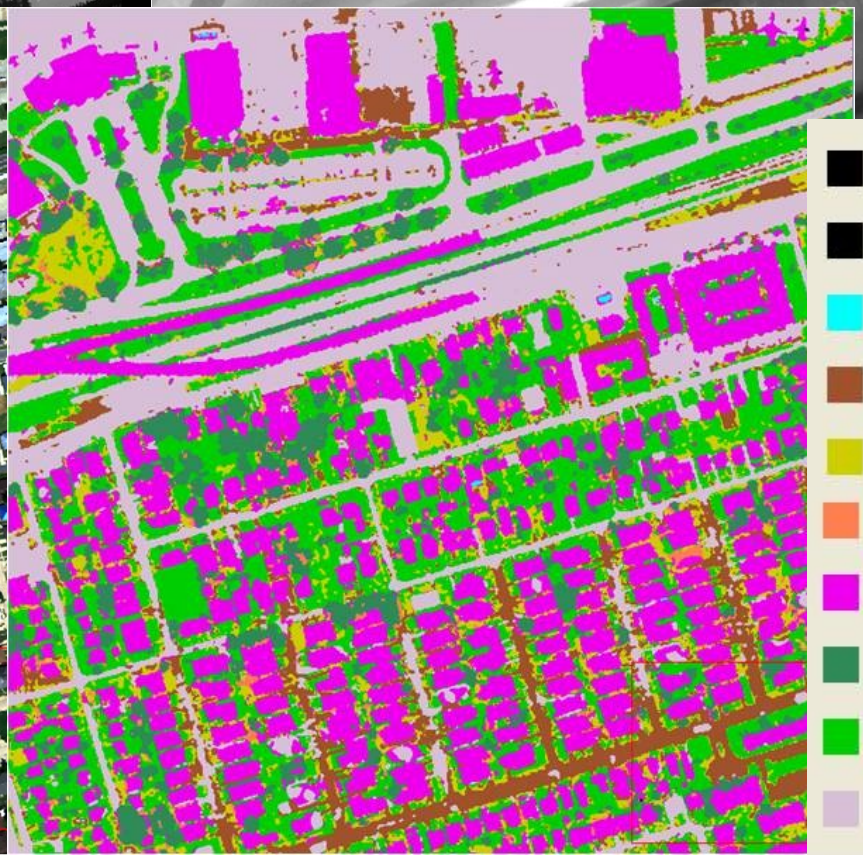


General Tree Classification

With Lidar







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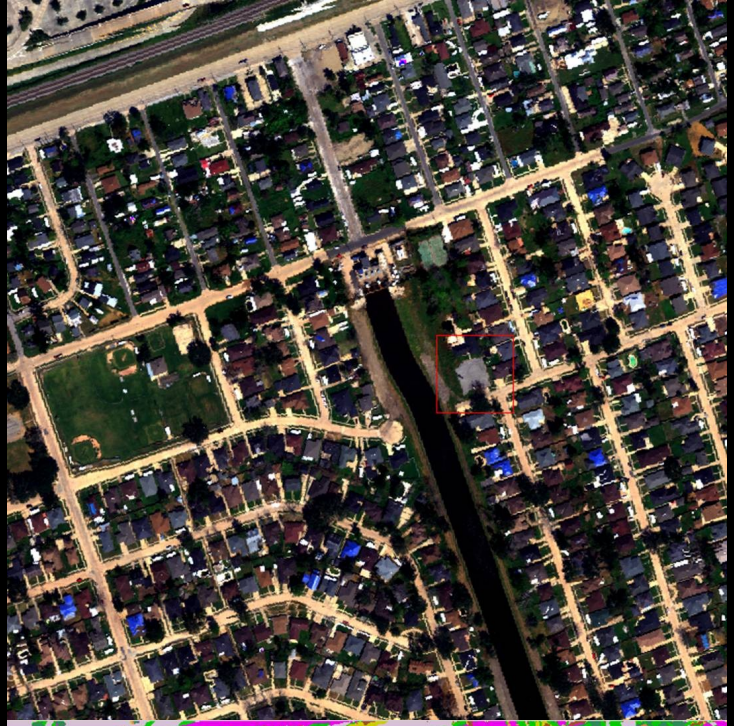
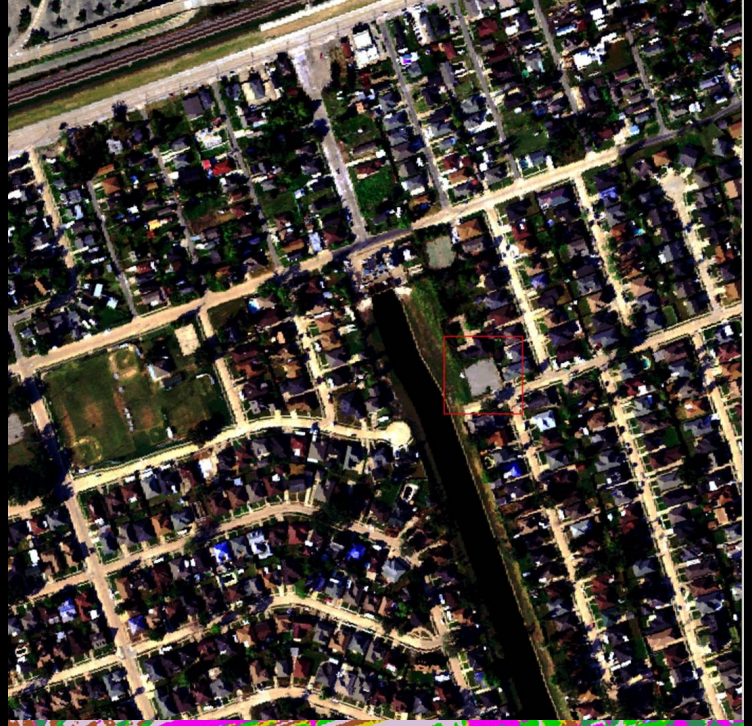
Comparison: 2006 – 2007

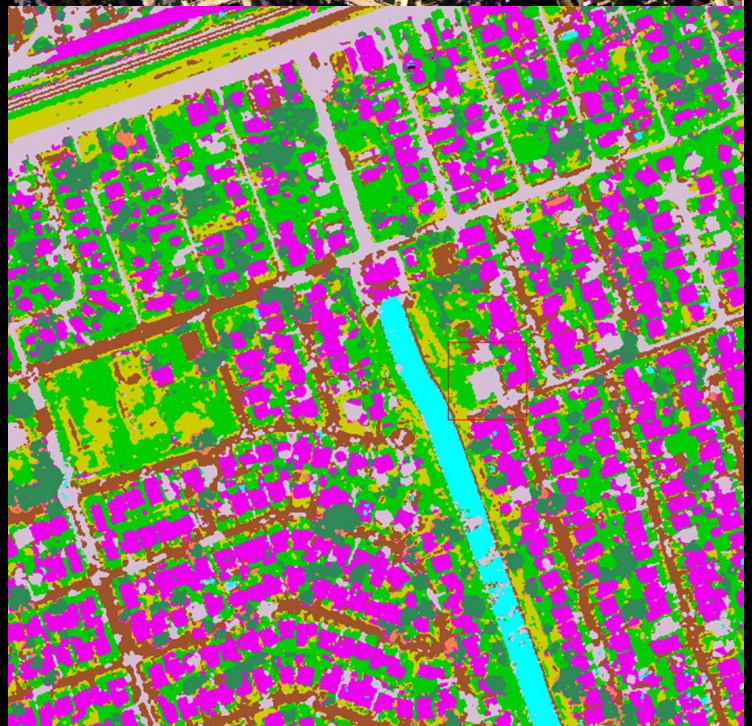
Percent Change:

	Saturated Pixels	Water	Ground	Low Brown Veg	Tall Brown Veg	Buildings	Tall Green Veg	Low Green Veg	Roads
Unclassified	0.000	1.669	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Saturated Pixels	0.245	0.000	0.002	0.000	0.002	0.003	0.003	0.000	0.000
Water	1.364	97.597	3.121	0.448	0.431	3.545	0.293	0.218	3.880
Ground	0.655	0.102	41.713	14.585	7.114	3.658	2.953	9.244	13.954
Low Brown Veg	0.218	0.012	7.927	26.748	6.516	0.853	4.050	26.146	1.351
Tall Brown Veg	0.164	0.001	0.600	0.924	12.986	1.233	7.939	0.704	0.103
Buildings	94.544	0.127	9.276	1.776	24.247	79.692	10.957	0.967	6.400
Tall Green Veg	0.136	0.003	1.204	2.538	30.004	2.436	59.140	3.768	0.274
Low Green Veg	0.109	0.039	10.795	46.963	15.230	1.460	12.945	56.497	1.679
Roads	2.564	0.449	25.362	6.018	3.471	7.119	1.720	2.455	72.358
Class Total	100.000	100.000	100.000	100.000	100.000	100.000	100.000	100.000	100.000
Class Changes	99.755	2.403	58.287	73.252	87.014	20.308	40.860	43.503	27.642
Image Difference	-98.718	13.178	36.757	33.665	-7.632	17.053	9.534	-22.506	-9.874

Area (m^2) Change:

	Saturated Pixels	Water	Ground	Low Brown Veg	Tall Brown Veg	Buildings	Tall Green Veg	Low Green Veg	Roads
Unclassified	0.00	56427.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Saturated Pixels	9.00	3.00	7.00	0.00	1.00	15.00	5.00	1.00	6.00
Water	50.00	3298980.00	12960.00	1837.00	213.00	17084.00	577.00	3111.00	47983.00
Ground	24.00	3431.00	173188.00	59789.00	3513.00	17626.00	5814.00	131859.00	172559.00
Low Brown Veg	8.00	409.00	32914.00	109649.00	3218.00	4110.00	7973.00	372957.00	16706.00
Tall Brown Veg	6.00	27.00	2491.00	3789.00	6413.00	5940.00	15629.00	10049.00	1271.00
Buildings	3466.00	4297.00	38512.00	7280.00	11974.00	384019.00	21572.00	13791.00	79139.00
Tall Green Veg	5.00	102.00	5000.00	10406.00	14817.00	11739.00	116430.00	53751.00	3391.00
Low Green Veg	4.00	1329.00	44820.00	192519.00	7521.00	7037.00	25486.00	805902.00	20768.00
Roads	94.00	15186.00	105299.00	24668.00	1714.00	34307.00	3386.00	35020.00	894764.00
Class Total	3666.00	3380191.00	415191.00	409937.00	49384.00	481877.00	196872.00	1426441.00	1236587.00
Class Changes	3657.00	81211.00	242003.00	300288.00	42971.00	97858.00	80442.00	620539.00	341823.00
Image Difference	-3619.00	445449.00	152613.00	138007.00	-3769.00	82173.00	18769.00	-321037.00	-122095.00



Summary

- **Processing time of the GTC is ¼ of the Maximum Likelihood Classification**
- **Repeatable results with minimal user interaction**
- **The same results from different users**

Future Work

- **Improve the ground and road classification**
- **Segment the hyperspectral image using the classification image to improve specialized classifications**

Questions?/Comments

Christopher Macon

Joint Airborne Lidar Bathymetry Technical
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christopher.l.macon@usace.army.mil

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